ORAL CONTRIBUTIONS

861 Aortic Disorders: Novel Echocardiographic Approaches

Tuesday, April 01, 2003, 4:00 p.m.-5:00 p.m.
McCormick Place, Room S102

4:00 p.m.

861-1 Improved Visualization of Aortic Plaques With the Use of Definity, an Echocardiographic Contrast Agent

Serena M. Bierig, Steven C. Herrmann, Alan Maniet, Arthur J. Labovitz, Saint Louis University, Saint Louis, MO

Introduction: Transesophageal echocardiography (TEE) has been used to diagnose atherosclerotic disease in patients that present with systemic embolic event. A recognized limitation of TEE in the evaluation of atherosclerotic disease derives from intima-media border identification. Echocardiographic contrast agents traditionally have shown enhanced border detection of the cardiac chambers especially in suboptimal standard imaging. The primary aim of this research project is to assess the supplemental value of echocardiographic contrast to TEE in identifying atherosclerotic disease compared to standard TEE imaging in a prospective study of imaged subjects with a suspected cardiac source of embolus.
Methods: 44 patients undergoing TEE with standard imaging protocols were evaluated for visualization of the thoracic aorta. Following adequate imaging of the ascending, descending and arch of the aorta, .3cc of DefinityTM was administered intravenously with a slow flush following. Pre and post contrast images were digitally acquired and analyzed offline for border detection and cross-sectional area. A cross section of the aorta was taken at the level of the thoracic aorta and segmented into anterior, lateral and medial wall segments. Aortic border enhancement was graded as 2=Well-defined, 1=Difficult to Visualize, 0=unable to visualize.
Results: The anterior wall showed the greatest increase in visualization with the average non-contrast score of 1.29 with contrast improvement to and average of 1.66 (p=. 001). The lateral wall improved from an average score of 1.78 to an average of 1.93 (p=. 05). Overall only 76% of segments were well visualized without contrast. After contrast enhancement, 92% of all segments were well visualized. The average cross-sectional area also increased from 4.5 to 6.3 with contrast enhancement (p=. 02).
Conclusion: Contrast agents provide better aortic intimal enhancement during TEE especially in the more problematic near field segment. Contrast provides additional and more accurate diagnostic information to evaluate aortic atherosclerotic disease.

4:15 p.m.

861-2 Do Left-Sided Echo Contrast Agents Improve Diagnostic Accuracy of Transesophageal Echocardiography in Patients With Suspected Aortic Dissection?

Matthias R. Schulze, Yvonne Franke, Stefan A. Lange, Steffen P. Schoen, Alexander Schmeisser, Ruth H. Strasser, Technical University of Dresden, Dresden, Germany

Background: Transesophageal echocardiography (TEE) has a high sensitivity and specificity to diagnose a suspected aortic dissection (AD) by interpretating 2D, M-Mode, and colour doppler information. Contrast echocardiography is widely used for assessment of left ventricular wall motion in patients with poor image qualities. At present it is not known if contrast echocardiography gives further information in patients with suspected AD.
Methods: TEE with contrast echocardiography was performed in 45 consecutive pat. (33 m; 12 f; mean age 64+/-14 y) with unexplained thoracic pain and suspected AD (clinical, computertomography, TEE) . 13 pat. had a prior cardiovascular operation (aortic valve replacement, coronary bypass, ascending aortic conduit; supracoronary aortic prothesis).During TEE examination one or more boli of echocardiographic contrast agents (CA; Optison) able to crossing the pulmonary vascular bed were given intravenously.
Results: An AD and/or perforation could be detected in 15 pat. (n=6 Type A; n=5 Type B; n=1 Type B and perforation; n=2 Type A and perforation of the aorta; n=1 traumatic aortic rupture) and in 5 preoperated pat. with aortic conduits or supracoronary aortic prothesis perforation sites could be diagnosed. After intravenous administration of CA there was an initial shadowing of the ascending aorta by CA in the left atrium and the pulmonary artery. This effect disappeared after a few seconds and the lumen and wall of the ascending and descending aorta could be visualized with a clear delineation of the aortic wall especially in preoperated pat. and pat. with large aortic aneurysms. Only with CA a dissecting membrane could be diagnosed or better visualized in 4 pat., and in all pat. more entrys/reentrys could be detected. In preoperated pat. there was a better visualizaton of perforation sites between native aorta and aortic conduit with CA. In 1 pat. with a large aortic aneurysm only with CA thrombotic material was detected inside the aorta.
Conclusion: CA greatly improves diagnostic accuracy of TEE in pat. with suspected aortic dissection by better identification of dissecting membranes and detection of entries/reentries, perforation sites, and thrombotic material.

4:30 p.m.

861-3 Association of Echocardiographic Aortic Root Dilatation With Aortic Dissection: A Case Control Study

Richard B. Devereux Daniel Morrison, Mary J. Roman, Leonard N. Girardi, Searle Levin, Rebecca T. Hahn, Jennifer E. Liu, Dawn Fishman, Weill Cornell Medical Center, New York, NY

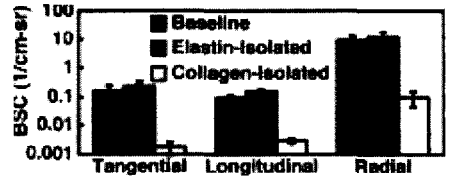
Background: Aortic dissection carries a high case-fatality rate but the ability to identify individuals at high risk of dissection and thus institute preventive medical and/or surgical management is limited. Methods: To quantify the strength of association between dilatation of aortic root detected by echocardiography, 47 consecutive cases undergoing surgery for aortic dissection distal to the sinuses of Valsalva and 141 age-sex matched control subjects (both 70% men, mean age 63 years) had aortic diameter measured by intraoperative transesophageal echocardiography. Results: Aortic root diameter was substantially greater in cases with aortic dissection than in controls in both absolute terms (4.12±0.72 versus 3.32±0.39 cm) and as a percent of the value predicted for age and body size (125±25 versus 101±11%, both p<0.001). Aortic diameter exceeded the upper limit of the 95% confidence interval of normal values in 24/47 (51%) cases but only 4/147 (3%) controls (odds ratio for the association of sinuses of Valsalva dilatation =18.0, 95% CI =6.6-49.2, p<0.0001). Even more aortic dissection patients (26/47 or 55%) but few control subjects (3/141 or 2%, p<0.001) had aortic dilatation by the more sensitive method of relating observed aortic diameter to that predicted for age and body size (odds ratio = 26, 95% CI 8.2-82.0). Conclusions: Aortic dilatation at the sinuses of Valsalva detected by echocardiography is associated with 20-25 fold higher likelihood of aortic dissection. This finding suggests that meticulous blood pressure control and imaging to identify enlargement of other aortic segments meeting criteria for surgery may help prevent aortic dissection in patients with sinuses of Valsalva dilatation.

4:45 p.m.

861-4 Ultrasonic Tissue Characterization Defines the Specific Role of Elastin in Maintaining Aortic Structural Integrity and Compliance

Jon N. Marsh, Shin Takiuchi, Samuel A. Wickline, Washington University School of Medicine, St. Louis, MO

Background: Destruction of elastin is involved in pathologies that lead to aneurysm and dissection. However, current clinical methods cannot assess microstructural changes in the elastin matrix in conditions such as Marfan syndrome. We sought to develop acoustic methods to define the role of elastin in determining the physical properties of elastic vessels.
Methods: Porcine aortas were excised, fixed in formalin, and sectioned for scanning with a 50 MHz acoustic microscope. Medial aortic layers were scanned either along or tangential to the vessel axis, or perpendicular to the vessel wall. Elastin-depleted (collagen isolated) or collagen-depleted (elastin isolated) samples were produced by treatment with 10% NaOH or 88% formic acid, respectively. Ultrasonic indexes of fiber organization were measured before and after digestion.
Results: Loss of elastin resulted in decreased attenuation (ATN), backscatter (BSC), and speed of sound (SS) as compared with baseline. Loss of elastin, but not collagen, reduced SS, which is an index of vascular compliance. BSC was greatest in the perpendicular direction for all treatments, and ATN was greatest tangentially, concordant with known fiber orientations.
Conclusion: These methods specifically address the structural integrity of the aortic elastin matrix, which plays a dominant role in determining the physical properties of unloaded elastic vessels. These methods could be useful for assessing microscopic structural damage to aortas that lead to dissection.



ORAL CONTRIBUTIONS

870 Coronary Angiography by CT/MRI

Wednesday, April 02, 2003, 8:30 a.m.-10:00 a.m.
McCormick Place, Room S103

8:30 a.m.

870-1 Noninvasive Coronary Angiography With 16-Slice Detector Computed Tomography: Initial Experience

Stephen Schroeder, Andreas F. Kopp, Axel Kuettner, Tobias Traboldt, Martin Heuschmitt, Thorsten Beck, Christof Burgstahler, Thomas Athanasiou, Ludger Seipel, Claus D. Claussen, University of Tuebingen, Tuebingen, Germany

Background: Multi-slice detector-CT (MDCT) systems with retrospective ECG-gating permit visualization of the coronary artery tree with good image quality. However, 4- slice technology was limited in evaluating vessel segments with a lumen diameter < 2 mm.

Since 3/2002 a new scanner generation using a 16- slice detector technology is available, which allow also a non-invasive look at distal vessel segments and side branches. The aim of the present ongoing study was to evaluate the diagnostic accuracy in detecting coronary lesions using this new technology.
Methods: 54 patients (pts) were examined with new 16-slice MDCT technology (Sensation 16 ™, Siemens, Forchheim, Germany). Parameter settings are: 0.75 mm collimation, 2.8 mm table feed/rotation, cranio-caudal scan direction, 80 cc contrast media with biphasic injection protocol. 15 vessel segments were assessed in each pt with respect to image quality and presence of coronary artery lesions. Results were compared to conventional coronary angiography (CCA).
Results: 745/810 (92%) of all vessel segments showed diagnostic image quality and could be evaluated for the presence of atherosclerotic plaques. Sensitivity in the detection of coronary lesions was calculated as 90%, and specificity as 95%. The clinically leading stenosis, as determined by CCA, could be detected by MDCT in 49/ 54 (91%) cases.
Conclusions: Our initial clinical data indicate that image quality could be further improved significantly by the introduction of 16- slice scanners. Our results hold promise that MDCT might become important in the non-invasive determination of CAD in the near future. Prospective, randomized, multi-center studies are now required to evaluate its diagnostic accuracy in clinical practice.

8:45 a.m.

870-2 Noninvasive Coronary Angiography by Retrospectively Electrocardiographically-Gated, Thin-Slice Multidetector-Array Computed Tomography

Dieter Ropers, Ulrich Baum, Karsten Pohle, Katharina Anders, Stefan Ulzheimer, Bernd Ohnesorge, Christian Schlundt, Werner Bautz, Werner G. Daniel, Stephan Achenbach, University of Erlangen-Nürnberg, Erlangen, Germany, Institute of Diagnostic Radiology, University of Erlangen-Nürnberg, Erlangen, Germany

Background: Multidetector-array computed tomography (MDCT) with intravenous contrast injection and ECG-correlated image reconstruction has been shown to permit coronary visualization. Limited spatial resolution, however, and motion artifacts frequently prevented adequate visualization of coronary segments. We analyzed the accuracy of a new 16-slice MDCT scanner with improved spatial resolution for detection of coronary artery stenoses.
Methods: A total of 77 consecutive patients (50 men and 27 women, mean weight, 82 ± 16 kg, mean age, 58 ± 14 years) referred for invasive angiography due to suspected coronary disease were studied by MDCT (12 x 0.75mm cross-sections, 420 ms gantry rotation time, table feed 2.8 mm/rotation, 100 ml contrast agent i.v. at 5 ml/s). Patients received 50 mg atenolol 60 minutes prior to the scan if the heart rate was above 60/min. In the axial MDCT images and multiplanar reconstructions, all coronary artery segments with a diameter of 1.5 mm or more were assessed concerning the presence of occlusions or stenoses exceeding 50% diameter reduction. Results were compared to quantitative coronary angiography.
Results: The mean heart rate was lowered from 69/min (range 51 to 92/min) before to 62/min (range 43 to 97/min) during the scan. 270 of 308 coronary arteries (left main, left anterior descending, left circumflex and right coronary artery, including their respective side branches in 77 patients) could be evaluated (88 %). In evaluable arteries, 57/65 significant lesions were detected and absence of occlusion or stenosis exceeding 50% diameter reduction was correctly identified in 191/205 arteries (sensitivity 88 %, specificity 93 %). In those 34 patients with a heart rate below 60/min, 96% (130/136) of the coronary arteries were evaluable. In this patient group, a sensitivity of 91% (30/33) and a specificity of 90% (87/97) was found for evaluable coronary arteries.
Conclusion: MDCT scanning with improved spatial resolution and routine premedication with oral beta blockade permits high-resolution imaging of the coronary arteries in the majority of patients and detection of coronary artery occlusions and significant stenoses with high sensitivity and specificity.

9:00 a.m.

870-3 Libman-Sacks Vegetations Are Associated With Cerebrovascular Disease in Patients With Systemic Lupus Erythematosus

Erika A. Gelgand, Wilmer G. Sibbitt, Carlos A. Roldan, Veterans Affairs Medical Center, Albuquerque, NM, University of New Mexico Health Sciences Center, Albuquerque, NM

Background. Cerebrovascular disease in patients (pts) with systemic lupus erythematosus (SLE) is believed to be due to cerebritis, vasculitis, or hypercoagulability rather than to cardioembolism. The lack of association of valve disease and cerebrovascular disease in SLE pts may be related to the limited sensitivity of transthoracic as compared to transesophageal echocardiography (TEE) for detecting Libman-Sacks vegetations. Methods. Tewnty-two SLE pts (18 females, mean age 43±13years, SLE duration of 8±7 years) with clinically suspected cerebrovascular disease underwent cerebral magnetic resonance imaging (MRI) and TEE. MRI and TEE studies were independently interpreted by experienced observers. Results. On MRI, 5 pts (23%) had recent or old cerebral infarct; 10 (45%) had peripheral white matter abnormalities; and 9 (35%) had deep white matter abnormalities. On TEE, 11 pts (50%) had 19 Libman-Sacks vegetations (12 on the mitral and 7 on the aortic valve). Of clinical relevance, more pts with MRI abnormalities had Libman-Sacks vegetations than those without MRI abnormalities. Four of 5 pts (80%) with cerebral infarct, 7 of 10 (70%) with peripheral and 5 of 9 pts (56%) with deep white mater abnormalities had Libman-Sacks vegetations (p=0.31, 0.19, and 1.0, respectively). In a stepwise logistic regression analysis adjusted for age, Libman-Sacks vegetations was the best predictor for the presence of MRI abnormalities (odds ratio of 7.9; 95% CI 0.69-90; p=0.09). Conclusion. In SLE pts with cerebrovascular disease, Libman-Sacks vegetations by TEE are common (50%) and Libman-Sacks vegetations are more prevalent in pts with cerebrovascular disease than in those without it. Therefore, cardioembolism from Libman-Sacks vegetations shoud be considered in SLE pts with cerebrovascular disease. However, these findings need to be confirmed in a larger population.

9:15 a.m.

870-4 Assessment of Coronary Remodeling in Stenotic and Nonstenotic Coronary Atherosclerotic Lesions by 16-slice Spiral Computed Tomography

Stephan Achenbach, Dieter Ropers, Udo Hofmann, Ulrich Baum, Katharina Anders, Karsten Pohle, Stephan Wicky, Werner G. Daniel, Tom J. Brady, Massachusetts General Hospital, Boston, MA, University of Erlangen, Erlangen, Germany

It has been hypothesized that failure of compensatory remodeling may contribute to the development of significant coronary artery stenoses. Sufficient image quality provided, multi-slice spiral CT (MSCT) permits visualization both of the coronary artery lumen and of the outer vessel boundary. We analyzed remodeling in stenotic and non-stenotic coronary artery lesions by MSCT.
In 80 patients, MSCT (16-slice scanner, i.v.contrast, 0.75 mm collimation, 420 ms rotation time, ECG-correlated image reconstruction) was performed prior to invasive coronary angiography. 14 patients without angiographic stenosis but detectable atherosclerotic plaque in MSCT and 14 patients with a proximal coronary stenosis exceeding 50% diameter reduction, all with high-quality MSCT data sets, were chosen for evaluation. In multiplanar reconstructions orthogonal to the coronary artery, the maximum vessel diameter in mm (VD) and the total vessel area in cm² (VA) were measured in MSCT for the respective lesion and for a reference segment immediately proximal to the lesion. The "Remodeling Index" (RI) was calculated by dividing VD and VA in the lesion by VD and VA in the reference segment.
Both for VA and VD, the mean remodeling index was significantly lower for stenotic than for non-stenotic lesions (see table).
In conclusion, MSCT permits assessment of coronary remodeling. The data support the hypothesis that inadequate remodeling may be involved in the development of coronary artery stenoses.

	Stenotic Lesions	Non-Stenotic Lesions	p-value
Lesion VD (mm)	4.9±1.1	5.3±1.4	0.41
Lesion VA (cm²)	0.22±0.1	0.27±0.1	0.37
RI (VD)	1.1±0.1	1.2±0.1	0.017
RI (VA)	1.1±0.2	1.4±0.1	0.002

9:30 a.m.

870-5 Four-Pixel Velocity Analysis Is the Preferential Approach in Evaluating Magnetic Resonance Velocity Maps of Coronary Artery Bypass Grafts

Liesbeth P. Salm, Susan E. Langerak, Hubert W. Vliegen, Wouter Jukema, Jeroen J. Bax, Aeilko H. Zwinderman, Ernst E. van der Wall, Albert de Roos, Hildo J. Lamb, Leiden University Medical Center, Leiden, The Netherlands, Interuniversity Cardiology Institute of the Netherlands, Utrecht, The Netherlands

Background: Phase-contrast Magnetic Resonance (MR) velocity maps can be evaluated by measuring volume flow or velocity. The workload of both methods differs considerably. Whether their accuracy differs is unknown. We hypothesized that both approaches may give comparable results in the analysis of coronary artery bypass grafts. **Methods:** Patients with recurrent chest pain after bypass surgery underwent both coronary angiography and MRI with velocity mapping of the grafts at rest and during adenosine stress. Post-processing volume flow (whole vessel) and velocity (4 pixels) analyses were performed and compared. **Results:** In 130 venous and arterial bypass grafts in 69 patients volume flow and velocity parameters were measured. The duration of one volume flow analysis was 25.9 ± 4.3 min.; one velocity analysis took 11.1 ± 2.2 min. Highly significant correlations were found when comparing volume flow and velocity parameters (for all parameters, p<0.01). Comparison of ROC areas under the curve of both analyses revealed no significant difference for detection of stenoses ≥70%. In single vein grafts the sensitivity/specificity/diagnostic accuracy for the volume flow were 91%/92%/92% and for the velocity parameters 96%/92%/93%, respectively. **Conclusion:** In the analysis of MR velocity maps in bypass grafts four-pixel velocity analysis is at least as accurate as volume flow analysis and significantly less time consuming. Therefore, velocity analysis may be considered the preferential approach in the analysis of MR velocity maps of bypass grafts.

9:45 a.m.

870-6 Adaptive Real-Time Architecture in Magnetic Resonance Coronary Angiography: Clinical Study

Patricia K. Nguyen, Juan Santos, Greig Scott, Jan Engvall, Graham Wright, Michael McConnell, Craig Meyer, Dwight Nishimura, John Pauly, Bob Hu, Phillip C. Yang, Stanford Medical Center, Palo Alto, CA

Introduction: The clinical utility of MR coronary angiography (MRCA) is currently limited by image quality, anatomic coverage, and scan protocol. In order to address these issues, we developed an adaptive real-time architecture (*a*RT). The *a*RT dynamically reconfigures pulse sequences and instantaneously selects the desired element on a